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MONOGRAFIJE CPA

Minimum Standards FOR ARCHAEOLOGICAL INVESTIGATIONS

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Table of contents

1 Introduction

Archaeological heritage is facing many threats due to ongoing land development, which includes intensive agriculture, construction of linear infrastructure , expansion of industrial areas and housing developments, and increasingly dispersed settlement.

Such a situation calls for other ways of protecting the archaeological heritage, since "rescuing", i.e. recording archaeological heritage during spatial interventions is counterproductive for heritage and investors alike. Preventive archaeology is a novel concept: archaeological investigation is incorporated within the procedure of planning spatial interventions. Archaeology thus has become one of the partners in spatial development planning.

The beginnings of the concept of preventive archaeology in Slovenia reach back to the late 1980s, when Slovene archaeology developed a series of conceptual and methodological novelties, especially non-invasive field survey methods such as systematic fieldwalking survey, aerial photography, and geophysical survey. New ideas and methods were first put into practice within the major motorway construction project, resulting in a dramatic increase in the number and density of sites. The experience gained through the motorway construction project contributed significantly towards the change in the doctrine and organization of archaeological heritage protection.

The experience from the motorway project was the very basis for the formation of preventive archaeology practice, its implementation in the law, and the foundation of the Centre for Preventive Archaeology.[1]

This development reflects broader changes in the understanding of archaeological heritage and the role of archaeology, which resulted in the 1992 Valletta Treaty on the protection of archaeological heritage, ratified by the Republic of Slovenia in 1999. The principal points of the treaty – incorporation of archaeological investigations into the planning process and the "polluter pays" principle when archaeological heritage is endangered due to development – are also the basis of preventive archaeology itself.

Preventive archaeology is thus a modern way of archaeological heritage protection; archaeological features are understood as a source that needs sustainable and long-term management, especially through spatial planning. The main goal of preventive archaeology is no longer to excavate individual sites when they are endangered, but to acquire, through preliminary archaeological investigations, as much data on the archaeological features in space as possible. In the cases where archaeological features might be destroyed by spatial interventions, preventive archaeology is of crucial importance.

The main result of preliminary archaeological investigations is the map of archaeological potential: a document defining areas with potential archaeological features. In this way, preliminary archaeological investigations are incorporated in the planning phase of major spatial interventions and serve as the starting point when it comes to deciding on these interventions. Planners use these maps to avoid areas of high archaeological potential, which would demand long and expensive rescue excavations, destroying the archaeological features in the process.

To ensure the protection of archaeological remains, their professional investigation and removal, the Slovene *Cultural Heritage Protection Act* from 2008 ensured that archaeologists-conservators were included in the preparation of planning documents.[2]

Preventive archaeology is more than just a new way of protecting archaeological heritage in spatial context; it brings about conceptual changes in our understanding of what constitutes archaeological heritage and especially how archaeological heritage is created. The

1 Djurić 2007.

2 Štih 2012.

key innovation of preventive archaeology is the preliminary investigation phase, where, rather than individual sites, the archaeological potential of the area is examined. As part of the process of recognition, documentation, and evaluation of archaeological heritage, preventive archaeology includes the archaeological potential assessment phase.

The practice of preventive archaeology establishes a research strategy, which is divided into three phases. The first phase is a survey conducted in order to assess archaeological potential, followed by research to determine the content and composition of the site. As the last resort for protection, rescue excavation is used when the planned spatial intervention cannot be avoided. After an excavation, the archaeological remains in the research area are fully and permanently removed.[3] Each phase of the research ends with a report and usually there is a post-field phase, which includes the analysis of the field results and a synthetic report.

Thus, through the research strategy, the archaeological potential of the area is first assessed, based on the clues created by the presence of archaeological features in the area. Using the methods for assessing the archaeological potential, areas of high archaeological potential are defined. Only with the methods for establishing the size and structure of the site, an area of high archaeological potential can be confirmed as archaeological site or archaeological remains.

The surveys for the assessment of archaeological potential are extensive: they cover large areas and the methods used are cost-efficient and require relatively little time per unit of area.

This is based on desk-based assessment, especially on the so-called "historical analysis", i.e. the compilation and critical assessment of the existing data available in the archaeological literature, but also in the "grey literature" such as various unpublished reports, studies, expertise, and other references in the public media, in oral tradition, toponymy etc.

An important innovation of preventive archaeology in Slovenia is the systematic application of remote sensing methods, which enable us to observe the surface of the Earth from a distance. These methods include aerial photography, satellite images, laser imaging, thermal imaging, etc. Remote sensing methods are a quick, systematic, non-invasive, and relatively affordable means of acquiring the information about the archaeological features in a landscape. In Slovenia, airborne laser scanning (LiDAR) has proved very successful due to its capability to observe the ground under the forest cover, which makes it very suitable for Slovene conditions.[4]

Furthermore, the introduction and development of preventive archaeology in the Slovene practice of archaeological heritage protection coincides with the introduction of new geoinformation technologies. In order to manage large amounts of information and extensive survey areas, the use of modern geoinformation tools is required, especially geographic information systems (GIS). This is the only way in the long run to aggregate, upgrade, maintain and manage the large amount of information acquired in various ways.[5]

Various types of extensive fieldwalking survey are among the most common methods for the evaluation of archaeological potential by sampling the density of archaeological material on the surface,. The advantage of these surveys is that they are a relatively fast (and cheap) way of systematic sampling over large areas. There is only one major disadvantage: these methods document the damage, the surface record in the arable soil being, by its very definition, the processed residue of the stratified subsurface features. Fieldwalking surveys are non- or minimally intrusive methods for the assessment of archaeological potential. If field conditions require it, an extensive geophysical survey can be conducted. Minimally intrusive methods such as borehole drilling can also be used as a supplement to fieldwalking survey in areas where archaeological features are presumed to be buried.

While the spatial extent of the methods for the evaluation of archaeological potential is the entire territory of Slovenia, they are in practice limited to areas of individual projects. Therefore it is critical to have standardized sampling, which allows comparison of the results of individual projects.

3 Nadbath, Rutar 2012, 67—72; Rutar, Črešnar 2012.

4 Mlekuž 2009, 2012.

5 Nadbath, Rutar 2012.

The methods for assessing the extent and structure of archaeological features are more intensive than the methods for assessing the archaeological potential; the objective of the former is to define more precisely the archaeological features in terms of their age, preservation state, functionality, extent structure, and stratigraphy. The extent of the surveys is usually limited to areas of high archaeological potential. The most common methods used include: intensive fieldwalking surveys and shovel test pit surveys, geophysical surveys, borehole drilling, test pitting by hand and machine excavation of trial trenches. The selection of the method depends on the conditions and the expected results. Again, as with the methods for assessing the archaeological potential, it is critical to have standardized sampling, which allows quantitative comparison of surveys and integration of surveys from the entire area of Slovenia.

Archaeological excavation is the most intrusive research method, causing the destruction of archaeological features. It is the most complicated, the most intensive, the most expensive, and the most intrusive archaeological method. It requires a large organizational and logistical input and produces large amounts of data, which require complex and challenging post-excavation processing and interdisciplinary cooperation of specialists from many areas. Due to the destructive nature and cost of this method, excavation should only be used in exceptional cases, notably when the destruction of archaeological features cannot be avoided; the Valletta Treaty recommends the preservation archaeological features *in situ*. Nevertheless, in practice, archaeological excavation remains a significant and commonly used method.

Supplemental archaeological surveys are replacing excavation in the cases when archaeological features are specific, or when archaeological features have been damaged or destroyed. Among these surveys are structural analysis of standing architecture, documention of the damage, archaeological features and archaeological research during construction works (watching brief).

Underwater archaeological research is quite specific due to the environment in which it takes place, requiring specialist researchers and adapted methods.

The introduction of preventive archaeology into archaeological heritage protection was also revolutionary for the discipline itself. If decades ago archaeology was a predominantly academic discipline, the introduction of preventive archaeology means that the latter has become the central focus of archaeological practice. Archaeological heritage protection and preventive archaeology in particular are the largest employer of archaeologists; an overview of archaeological fieldwork in the last decade indicates that most of archaeological research is conducted within the context of preventive archaeology, with only a handful of pure research investigations. Preliminary archaeological evaluations are thus the main source of archaeological information.

The second aspect is the changed social role of archaeology; it is no longer only a discipline involved in the academic study of the past, but rather a discipline actively participating in the democratic decision-making process about archaeological heritage, spatial interventions, and the development of the country. Instead of monographic academic publications of individual problem areas, the main products of the discipline are now reports and documents, which allow decision-making on spatial interventions.

These changes exert pressure on the discipline; customers, investors, and decision makers demand that preliminary archaeological fieldwork should be rapidly conducted and affordable. This means that the operators are under considerable pressure and it can lead to a decrease in the quality of archaeological work. Therefore it is critical to have a reflection on quality control in the sphere of archaeological work and its products.

The Centre for Preventive Archaeology standards for archaeological fieldwork thus establish quality uniform procedures for archaeological work in all phases of archaeological investigations, and allow the possibility of comparing the results of individual investigations and projects, which enables the synthesis and integration of the results and is the foundation for further methodological development and better quality and efficiency of work. The Centre for Preventive Archaeology standards for archaeological investigations comply with the *Act on Archaeological Research*.

2 CPA Archaeological Investigation Starting Points

In accordance with the provisions of the new *Cultural Heritage Protection Act* (ZVKD-1) and coordination meetings between the representatives of the Ministry of Culture (MC), the Ministry of the Environment and Spatial Planning (MESP), and the Institute for the Protection of Cultural Heritage of Slovenia, Centre for Preventive Archaeology (IPCHS, CPA), designations of archaeological methods were agreed on in July 2009 (**Figure 1**). The same goes for their integration into the procedures of national spatial plans and preliminary investigations commissioned by the Ministry of Culture (**Figure 2**).

Preliminary archaeological investigations are not an end in themselves. The purpose of preliminary archaeological investigations is discovering the unknown (i.e. undocumented and unregistered) archaeological remains in space and their preservation. Hence the importance of our procedures and methods being readily understandable for other disciplines participating in spatial planning and management. The methods are numbered in order to facilitate clarity. In the documents of MESP, MC, and IPCHS, CPA, the methods are listed with numbers; e.g. Methods 1–7 (assessment of the archaeological potential of an area). Methods 8–13 (determining the content and structure of a site), Method 14 (archaeological excavation).

The methods tie in with the provisions of Point 27 of Article 3 in the ZVKD-1:

According to Point 27 of Article 3, a preliminary investigation is defined as: *"he investigation of heritage that has to be performed in order to"*:

- first indent, Point 27, Article 3: *"acquire the necessary data for the evaluation of heritage before spatial interventions or development*". This is in accordance with the above-mentioned coordination meetings and refers to the investigations for the assessment of archaeological potential of an area, i.e. Methods 1–7, performed in the areas with no registered cultural heritage;
- second indent, Point, 27, Article 3: *"clearly determine protective actions*" – these are the investigations for the identification of the content and composition of the site, i.e. Methods 8–13;
- third indent, Point 27, Article 3: *"remove the heritage in a controlled process before spatial interventions or development.*" – this refers to archaeological rescue excavation, i.e. Method 14.

The first two groups of preliminary archaeological investigations are of preventive nature and contain non-invasive to minimally-invasive methods, i.e. Methods 1–7, which assess the archaeological potential of the studied area; and minimally-invasive methods, i.e. Methods 8–13, which confirm the archaeological potential of the studied area and determine the content and composition of the site. In accordance with the results of Methods 1-7, the relevant national or municipal spatial plan is definitely defined in space.

The List of Archaeological Investigation:
1. Archival data assessment and analysis of existing data 2. Analysis of existing data 3. GIS analysis 4. Remote sensing methods: 4.1 Aerial photography (aerial survey, infrared, multi- and hyperspectral imaging) 4.2 LIDAR 4.3 Thermal imaging (infrared thermography) 4.4 Hydrographic surveys (Sidescan, multibeam and scanning sonar) 5. Extensive fieldwalking survey (off-site)** 6. Extensive manuel test pit survey (off-site)** 7. Geophysical surveys – extensive (GPR, Electrical resistance, Electromagnetic conductivity, Magnetometry)** 8. Intensive fieldwalking survey (intra-site)** 9. Intensive manuel test pit survey (intra-site)** 10. Intensive underwater survey** 11. Borehole drilling, Test pitting by hand** 12. Machine excavation of test trenches and archaeological documenting** 13. Geophysical surveys – intensive (GPR, Electrical resistance, Electromagnetic conductivity, Magnetometry)** 14. Archaeological excavation **
** Post-field processing a. Processing of captured data b. Processing of the finds c. Specialist analyses, Site publication

Figure 1 *Designation of archaeological methods as coordinated between the Ministry of Culture and the Ministry of the Environment and Spatial Planning, July 2009.*

3 Minimum Standards Of Arcaheological Investigations

3.1. Minimum standards of desk-based assessment

Method 1-2 Archival data assessment and analysis of existing data[6]

Objectives and definition

The objective of historical spatial analysis and the analysis of existing data is to collect all the data from the existing sources on either known or assumed archaeological potential of an area. Historical spatial analysis includes collecting archaeological, historical, geographical, cartographic, and other sources, literature, graphic material, (older) cartographic material, cadastres, an overview of research history, etc. Where an analysis of existing data is concerned, the collected data should be compared and combined with the results from other data layers, thus obtaining the information about the state of research, the type and composition of known sites or potential sites, their extent, dating, preservation, but also possible destruction and consequently the absence of archaeological potential.

Gathering data within the framework of historical analysis of space encompasses the territory of the entire Republic of Slovenia. Gathering is non-selective and deals equally with the entire area of Slovenia; it is integrated, which means that it is not limited to the existing databases but includes all accessible sources and is continuous. Historical spatial analysis and the analysis of existing data are continuous processes, which do not end when a part of Slovenia has been processed. The material has to be collected and organized in a way that enables the next step, the so-called analysis of existing data, and the use of these contents in ge graphic information systems (GIS) for further analysis as well as permanent preservation and accessibility.

The team:

- Principal investigator: archaeologist – (equiv. to BA or MA in archaeology).

Selection and capture

Historical spatial analysis and the analysis of existing data are the necessary first step of every investigation. When investigations are planned at a site, they give an insight into the use of space in past centuries, whilst a composite plan of all past investigations serves as a baseline document for the planning and evaluation of further investigations.

Data capture non-selectively records all the data about past human presence in the area. The work is continuous. The data for the historical spatial analysis is collected and integrated in a geographic information system (GIS). The process of collecting, editing, and evaluating should be such as to allow simple use in all further stages of the research related to the studied area, so that instead of unnecessary duplications there is a deepening of knowledge (see **Method 3** *GIS Analysis*).

6 Archaeological evaluation of sources, bibliography, and other data (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

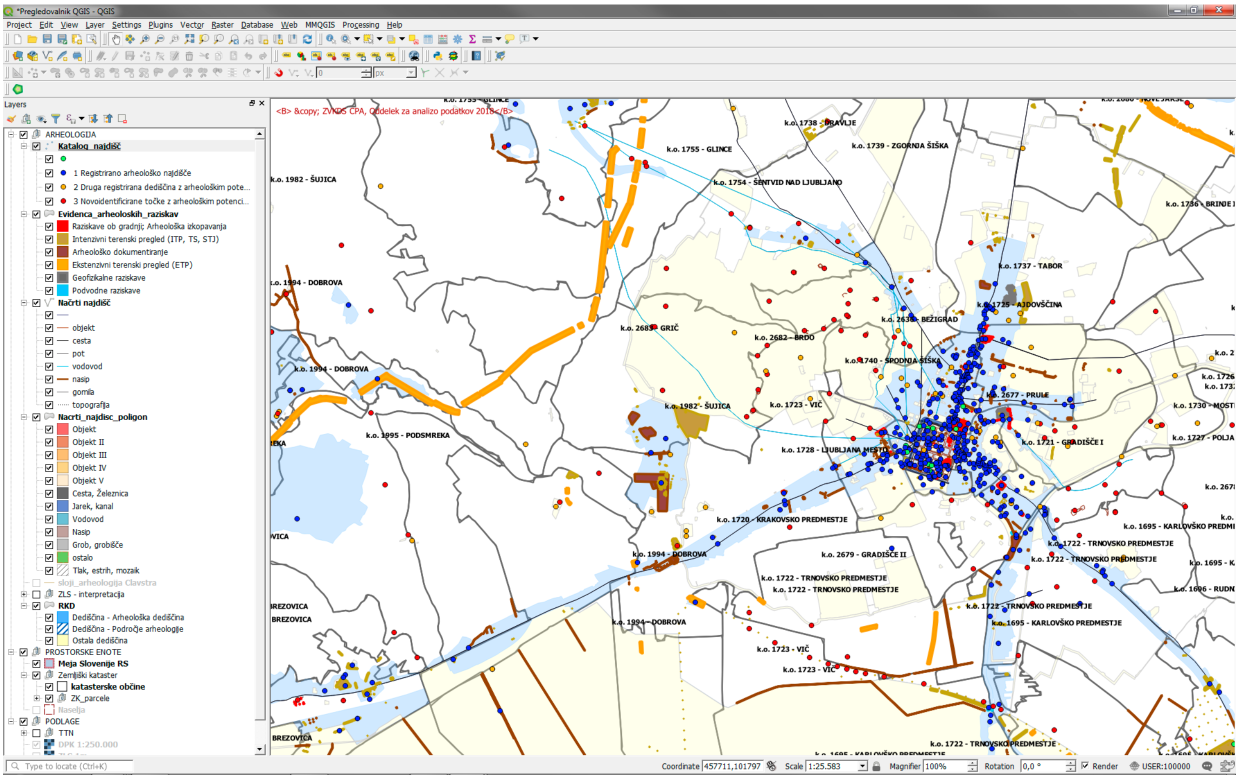

Figure 2 *Geographical information system of archaeological research CPA (archive IPCHS, CPA).*

Method 3 GIS analysis[7]

Objectives and definition

The objective of GIS analysis is collecting, editing, and combining data, as well as ensuring their permanent curation, preservation, complementarity, continuous use and availability. There are other more complex uses, such as mapping, visualisation of archaeological potential, spatial modelling and location analysis. GIS analysis is a continuous process and does not end at a point when an area has been processed.

The team:

- Principal investigator: archaeologist – (equiv. to BA or MA in archaeology).

Selection and capture

This is the integration of the data acquired by the archival data assessment and the analysis of the existing data, as well as the data acquired by other methods (remote sensing, field surveys) in GIS environment, which allows processing, interpreting, and visualisation of data. Data capture non-selectively records all the data about past human presence in the area. The work is continuous, covering the territory of the entire Republic of Slovenia.

7 Archaeological evaluation of sources, bibliography, and other data (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

Method 4 Remote sensing methods

Objectives and definition

The objective of remote sensing methods is the assessment of the archaeological potential of the area. Remote sensing methods allow us to observe and record the features that cannot be observed by other means – either because they are better captured and detected from aerial perspective or because different methods enable the observation of a landscape outside visible light . An advantage of the remote sensing methods is also that they are non-invasive. At the same time they allow fast and precise data capture for large areas. In addition to being non-invasive, they have, compared with all other research methods, the best ratio between the input and the final result. The acquired data often require field verification, which is the only way to obtain a correct interpretation. There are four groups of remote sensing methods: aerial photography, multi- and hyperspectral imaging, lidar, and hydrographic surveys (several methods).

Selection and capture

In certain segments the listed methods offer similar results. In many respects they are complementary and their use depends on the type of surface. Lidar is best suited for forests, less for open landscapes. Aerial photography and hyperspectral imaging are suitable for open landscapes, and hydrographic surveys are used in water environments. The interpretation of remote sensing methods is a continuous and non-selective process, covering the area of the entire Republic of Slovenia. Imaging is usually conducted by specialized organizations or the data is obtained from archives and public databases. The IPCHS CPA conducts the processing and archaeological interpretation of the data.

Aerial photography

Archaeological interpretation of aerial photographs allows for the observation and detection of archaeological markers that are either still preserved on the surface or are, due to certain conditions, projected onto the surface from subsurface layers. In both cases we are mainly concerned with the markers that are not visible or understandable from the ground, which are

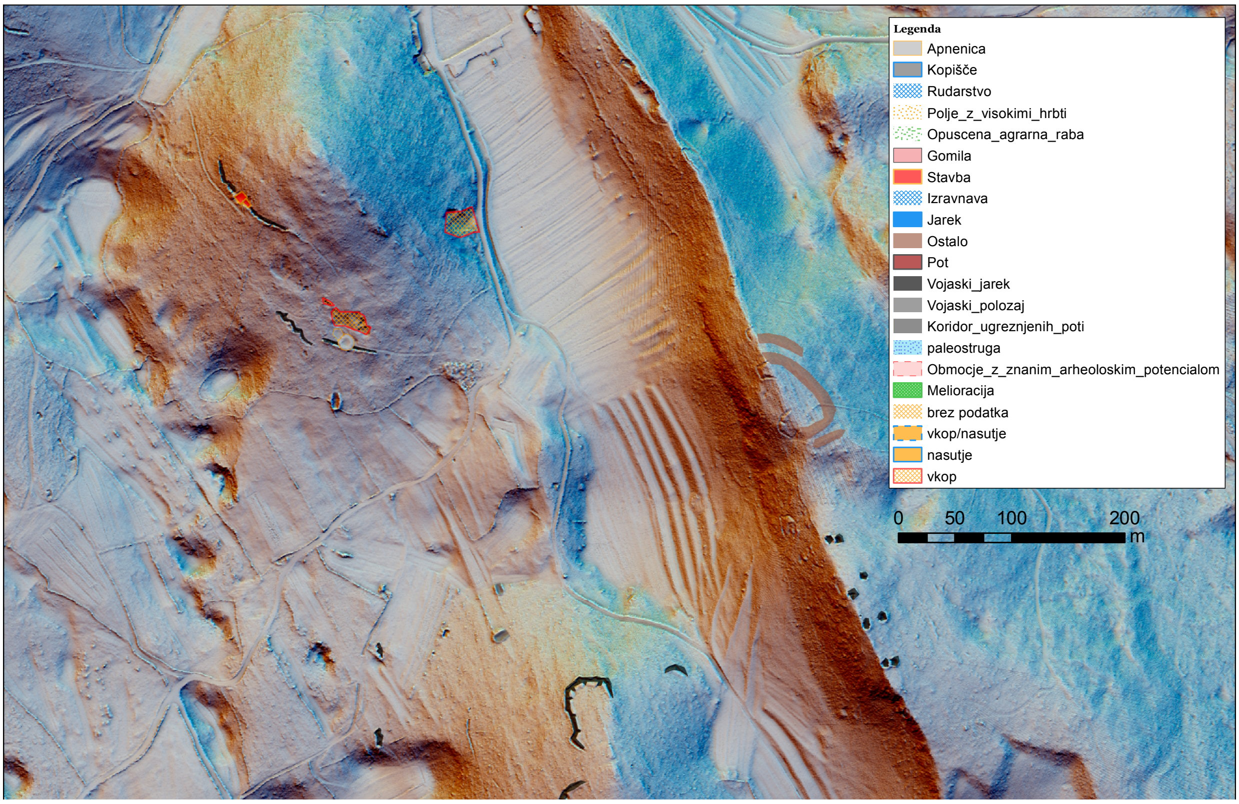

Figure 3 *Interpreted lidar image (archive IPCHS, CPA).*

given a whole new meaning if observed from a high altitude in a broader spatial context. The analysis of aerial photographs consists of two stages: systematically observing and recording the landscape from the air, and the analysis and interpretation of the images.[8] During both stages we can look for the indicators of the use of space in the past and the associated destruction of archaeological environment. By systematically and cyclically registering the state of the surface and by processing spatial data, we can keep defining new interpretation keys.[9] The images used can be vertical, ordinary or stereo pairs, or oblique, taken at different angles from different heights in different spatial and spectral resolutions.

The team:
- Principal investigator: archaeologist – BA or MA in archaeology.

LiDAR

Lidar (Light Detection And Ranging) or ALA (Airborne Laser Altimetry) combines the properties of coherent laser light and precise kinematic positioning, aided by a differential GPS (DGPS) and inertial instruments for precise horizontal and vertical measurements of the altitude of the Earth's surface. The laser projects light pulses onto the surface of the Earth, where they are reflected back to the receiver. The time a pulse needed to travel from the laser to the receiver serves to calculate the distance from the ground. The receiver also detects the amplitude (intensity) of the reflection. Differential GPS allows precise 3D positioning of the device, while inertial instruments provide data on the direction and angle of the aircraft. The entire device is composed of a laser scanner, a differential GPS, and inertial instruments, all linked to a computer monitoring the components and recording the data. Post-recording data processing allows a reconstruction of the elevations of the earth's surface. Raw data is usually, as a cloud of 3D points, projected into a local geographical projection; they are sorted, filtered, and used to generate raster surfaces. Lidar detects the height of the ground surface and of all non-transparent of half-transparent objects on the surface. The laser beam is reflected from the ground and from non-transparent objects on the ground (e.g. buildings). In the case of semi-transparent features such as trees and other vegetation, a part of the beam is reflected from the leaves and branches, while the rest of the beam reaches the ground surface. These reflections can be identified as several layers; usually there are the first pulse, which is the reflection from the surface of non-transparent objects such as trees, branches, etc., and the last pulse, which represents the ground surface under transparent objects. The fact that a laser beam can penetrate half-transparent objects is a great advantage compared to other remote sensing methods, which are limited by agricultural and vegetation cycles. There are, however, certain restrictions when it comes to lidar scanning: scanning of ground surfaces under deciduous forest is advisable in winter, while conifer forests still considerably impede the creation of a precise digital surface model. The lidar data containing all land surface details are usually referred to as a digital surface model (DSM). These data need to be processed and all the unwanted objects and details of the land surface, the landscape clutter, should be removed in order to get a bare earth land surface model, usually referred to as a digital terrain model (DTM). Landscape clutter is usually identified and removed with the use of different filters, while the cut-out surfaces are filled in by interpolation. Cleaning the bare surface is a critical part of the process since non-selective use of inadequate filters can cause the loss of the very details that are the object of the analysis.

The team:
- Principal investigator: archaeologist – BA or MA in archaeology.

Multi- and hyperspectral imaging

Multi- and hyperspectral imaging is a passive remote sensing method, characterized by a higher spectral

8 Wilson 1982, 10–15.

9 Palmer 1989, 55.

resolution, i.e. the capacity for precisely capturing certain parts of the electromagnetic spectrum. Hyperspectral imaging is characterized by a very high number of narrow and overlapping spectral bands, which allow a precise recording of the spectral signature of any image element. Furthermore, multi- and hyperspectral imaging usually records the parts of the electromagnetic spectrum beyond visible light (i.e. the ultraviolet and infrared parts of the electromagnetic spectrum). Multi- and hyperspectral imaging is therefore very suitable for identifying the differences in vegetation growth that are the indicators of subsurface archaeological features (the so-called vegetation marks). As such, they are an upgrade of the classical aerial photography.

The team:
- Principal investigator: archaeologist – BA or MA in archaeology.

Hydrographic surveys

Bathymetric LiDAR. The remote sensing method most commonly used in underwater archaeology is green laser lidar (the so-called bathymetric lidar), which is better suited for penetrating water. Its suitability for recording underwater sites depends on water conditions; in clear water it is possible to reach depths up to 50 m, but this shrinks to less than 10 m when the water is not clear. The resolution of bathymetric lidar is second-class in terms of precision and as for now it cannot be compared with the images made with a multibeam sonar.

The team:
- Principal investigator: archaeologist – BA or MA in archaeology.

Single- or multibeam sonar. Sound travels through water with the approximate speed of 1500 m/s, which depends on the pressure, salinity and temperature of the water. It covers relatively long distances. This fact is taken advantage of by several hydro-acoustic devices, the so-called SONAR, which transmit sound pulses and record the reflections. This allows the mapping not only of the natural seabed morphology, but also of anomalies that can be of anthropogenic origin.

The device is mounted on a moving boat or on a towed underwater vessel. It transmits an ultrasound pulse, which travels through water until it reaches a material of a different density, reflects from it, and the receiver detects the reflection and assigns it a specific value. The time passed between transmitting the signal and detecting the reflection represents the depth at the reflection point. The measurements follow each other and with a series of measurements in a grid, the surveyed seabed surface can be graphically drawn (the so-called sonogram). Since underwater visibility is often limited, sonars are useful especially in bad conditions.

Single beam sonar transmits one pulse ('ping') at a time, while multibeam sonar can transmit several pulses. Single beam sonars transmit the pulse within the angle 2–45°, while with more precise devices the angle is 0.5°. They work at frequencies between 15 and 600 kHz. A higher frequency means better precision in the measured depths. Sonars are predominantly used for a rapid generation of data on the seabed morphology and for the identification of archaeological remains in the sediment.

Modern multibeam sonars produce up to 400 pulses across a 160° arc and work at frequencies between 12 and 455 kHz. A multibeam sonar can measure a wider area; in good conditions it can cover the surface that is up to ten depths wide. Two overlapping patterns of rectangular lateral corridors are usually recorded. A multibeam sonar requires also the use of a DGPS receiver ad an inertial navigation sensor (the so-called gyrocompass).

Primary data is comprised of a multitude of georeferenced measurements of depths – a point cloud, which is usually transformed into another digital form of spatial data (rasters, isobaths). The most precise systems surpass the highest standard of measurements and allow the resolution of 5 cm in shallow waters.

The team:
- Principal investigator: archaeologist – BA or MA in archaeology).

Sidescan sonar. A sidescan sonar emits two fan-shaped (narrow in the horizontal direction and wide in the vertical) pulses obliquely down and outward from the course of the boat. In the 1960s, sidescan sonars were used for monitoring changes in object positions and for controlling divers in the vicinity of military infrastructure. The advantage of the sidescan sonar is that it detects a feature from the side. The reflected acoustic signals are graphically represented as shadows in the grey spectrum, showing the uneven surface of the studied area. The height of a feature can be calculated from the shadow cast by the signal and the known elevation of the sonar above the seabed. Sidescan sonars are relatively cheap and they can be mounted on small remotely controlled vessels. A sidescan sonar is comprised of a float (fish), which is slowly towed behind the research boat, and of a cable attaching it to the processor unit (computer) or any other display device. There are also some variants that are built into the shell of a vessel. Sidescan sonars work between 100 kHz (for better range) and 1200 kHz (for better precision). The width of the beam is 0.2–1.2 °, and it usually transmits at the angle of 40°. The angle can be adapted, based on the tolerable gap between two beams. On the screen, each pulse is represented as two narrow lines separated by an empty space – blindspot. For an investigation of an area, one needs a search pattern (usually transects), a relatively calm sea, and precise navigation. The result is usually a rough depiction of the seabed or a shipwreck. Yet in optimum conditions and with higher frequencies, a sonogram can be almost as sharp as a photograph. High intensities of reflections are depicted as light tones, while low intensities of reflections and shadows are depicted in dark tones. The interpretation of the images becomes more difficult if the sea is not calm: the otherwise level bottom then displays wavy irregularities/noise.

The team:
- Principal investigator: archaeologist – BA or MA in archaeology.

Submarines, remotely controlled vessels (AUV, ROV). This survey method is only used in the areas where diving is either limited or impossible, i.e. in deep oceans, seas, and lakes.
While submarines are managed by people who are themselves in the vessel, remotely controlled vessels are robotic and perform their task and navigate their way led by a computer programme and remote control (AUV), or are physically (cable) connected with the main boat where an operator directs the device (ROV). Different devices can be mounted on the vessel frame, performing their separate tasks: lights, photo and video cameras, robot arms, baskets, magnetometers, various sonars, acoustic positioning system, and other measuring instruments.

The team:
- Principal investigator: archaeologist – BA or MA in archaeology.

Sub-bottom profiler is a sonar that works at a much lower frequency range than surface sonar (2–24 kHz). This enables the sound to penetrate into the sediments and discover the buried remains and stratigraphy under the seabed surface, in the case of very soft sediments even up to 80 m deep. The pulse is reflected from the bottom and from the interfaces between layers and objects. It is well suited to the recording of stratigraphy in the wider context of a site, or for the detection of paleo-landscapes. The main disadvantages of sub-bottom profilers are a narrow band of coverage and the fact that a geological bore is required for an optimal interpretation of the results. Advanced systems using not only an active acoustic source but also a series of receivers in several lines, allow us to generate 3D volumetric data, which gives us both vertical and horizontal information.

The team:
- Principal investigator: archaeologist – BA or MA in archaeology.

Magnetometer. Magnetic survey allows for a systematic mapping of the strength of the Earth's magnetic field. Buried or submerged ferromagnetic materials alter the local natural magnetic field, which appears as an anomaly or as unnatural direction and strength of the magnetic field in the vicinity of these materials. The most commonly used device for underwater measurements is the proton magnetometer, which detects very small changes in magnetic field at an interval of one or two seconds. The magnetometer can be mounted on a vessel or attached to a float towed by the vessel just above the sea bottom. An appropriate mapping of the survey results enables the detection of any non-natural magnetic anomalies – materials that are usually a consequence of human activity.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.

3.2. Minimum standards of terrestrial research

Method 5 Extensive fieldwalking survey[10]

Objectives and definition

The objective of an extensive fieldwalking survey is the assessment of the archaeological potential of an area. An extensive fieldwalking survey is conducted in a previously unexplored area, outside protected archaeological sites in order to acquire basic data on the spatial distribution of archaeological finds.

This is a non-invasive method for recording archaeological remains on the surface, in ploughed soil. Extensive fieldwalking survey is conducted in linear transect on ploughed fields and other surfaces with a disturbed upper soil layer.

In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, a primary evaluation and recording of the finds, and a professional report. The method results in identifying areas of high archaeological potential.

The team[11]:

- Principal investigator: archaeologist –BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservat technician documentalist – equiv. to upper secondary education.
- 5 workers.

Selection and capture

Extensive fieldwalking survey is suitable for areas with a disturbed upper soil layer (fields). The surveyed area is fully covered and sampled and the method is complementary to Method 6. The method can be used in most landscapes, except on thick natural and man-made deposits (for example, archaeological layers can be buried under geological deposits, or under modern man-made deposits). The method includes a total collection on the surface of the collection unit. Capture density is standardized for the entire territory of Slovenia.

Figure 4 *Extensive fieldwalking survey in action (archive IPCHS, CPA).*

10 Archaeological extensive fieldwalking survey (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

11 Does not include post-field processing of the site and a report (applies to all field investigations).

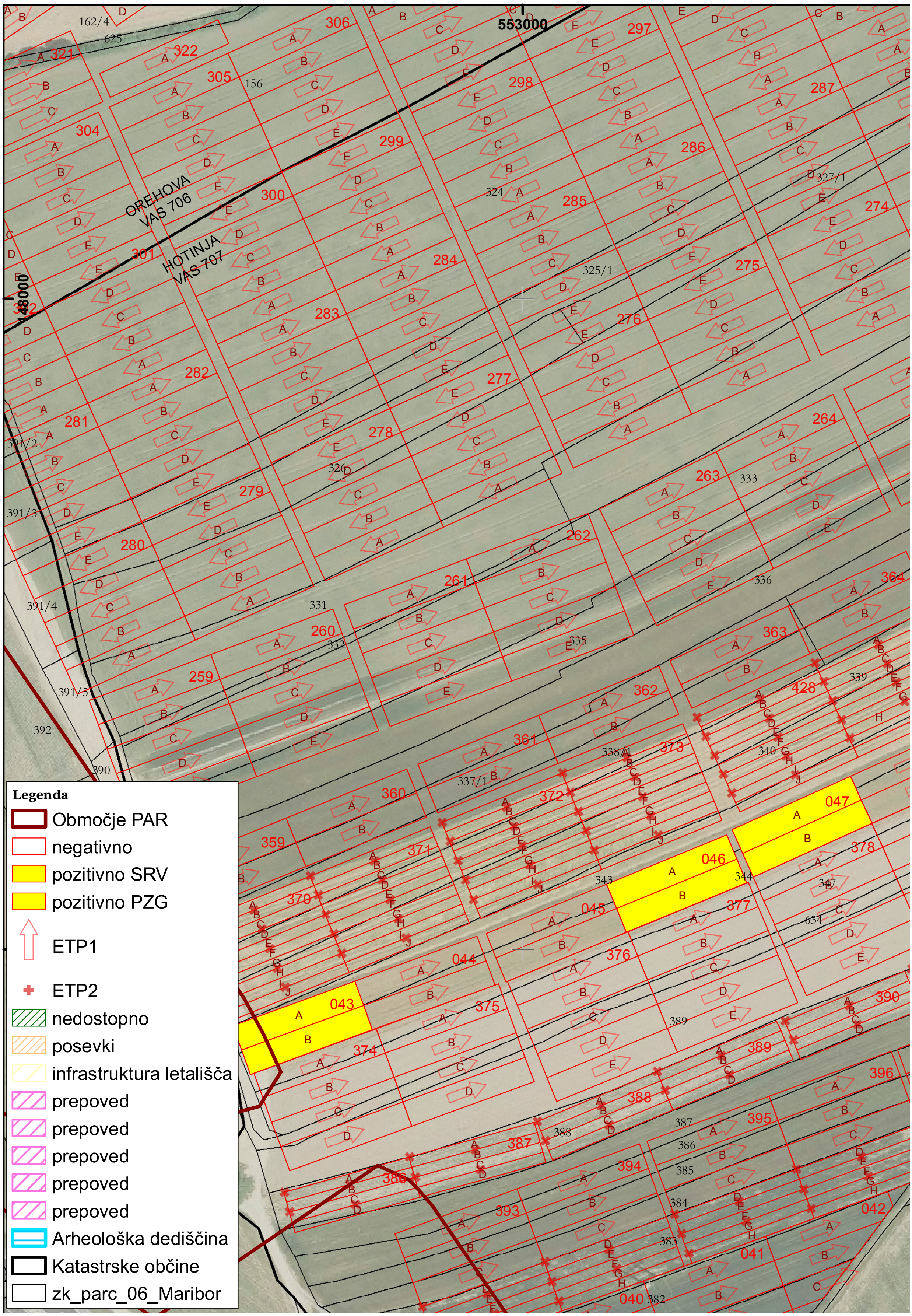

Figure 5 *Map of extensive fieldwalking survey results (archive IPCHS, CPA).*

Method 6 Extensive manuel test pit survey[12]

Objectives and definition

The objective of an extensive manuel test pit survey is the assessment of the archaeological potential of the area. An extensive shovel test pit (STP) survey is conducted in a previously unexplored area, outside protected archaeological sites in order to acquire basic data on the spatial distribution of archaeological finds. It is a low-invasive method of recording archaeological remains in test holes. Extensive manuel test pit survey is conducted in grasslands, forests, and other undisturbed surfaces.

In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, primary evaluation and recording of the finds, and a professional report. The method results in identifying areas of high archaeological potential.

The team:

- Principal investigator: archaeologist –BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education.
- 5 workers.

Selection and capture

Extensive manuel test pit survey is suitable for grasslands, forests, and other undisturbed surfaces. The surveyed area is fully covered and sampled and the method is complementary to Method 5. The method can be used in most landscapes, unless there is no soil at all (Karst Plateau) or in the rare cases where the ground was rapidly buried under thick natural and anthropogenic deposits (e.g. landslides, modern man-made deposits). The method is conducted by digging test holes. Capture density is standardized for the entire territory of Slovenia.

Figure 6 *Extensive manuel test pit survey in progress (archive IPCHS, CPA).*

12 Archaeological extensive shovel test pit subsurface

Method 7 Geophysical surveys – extensive[13]

Objectives and definition

The objective of geophysical surveys is assessing the archaeological potential of the area by identifying geophysical anomalies that can be interpreted as archaeological features.

Geophysical surveys are very non-invasive and allow the detection of remains (anomalies) by measuring certain physical properties of the subsurface record with no physical intrusion into the subsurface layers. There is a wide range of available methods; the most commonly used are electrical resistivity method, magnetic method, and ground penetrating radar (GPR) method.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education.
- 1 worker.

Figure 7 *Results of extensive geophysical survey on Krško polje (archive IPCHS, CPA).*

13 Geophysical surveys (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

Selection and capture

The choice of geophysical surveys and the selection of a method (or better, a combination of methods) are influenced by several related factors: area size, area limitations (electrical power lines, utility networks, geology), the expected 'type' of the archaeological site/record (the content and composition of the site, the depth of the remains, post-depositional processes), and other factors. Geophysical surveys encompass the area that is as large as possible within the circumstances. Geophysical methods depend on the natural conditions of the area (the geophysical properties of the subsurface record), and hence the principle is that since they are complementary to one another, the best results can be expected when using a combination of different methods. Natural conditions also demand a certain degree of flexibility when it comes to choosing the method. The selection of a method (electrical resistivity method, magnetic method, ground penetrating radar, etc.) depends strongly on the environment where the survey takes place, whether this is the geophysical properties of the subsurface record (pedological, geological, anthropogenic factors) or simply the fact that, if research is conducted in urban environment with buildings and castles, or in the vicinity of infrastructure lines (electrical power lines etc.), some methods are unsuitable. Further, it should be possible to use some new methods that are not among the above-mentioned most common ones (e.g. the otherwise very established method of measuring magnetic susceptibility, and the very-low-frequency EM method, which measures conductivity and magnetic susceptibility), or the methods that are only emerging (seismic method, self-potential method, thermal method, electrostatic method, electromagnetic and magnetic-tellurium methods of very low frequencies, as well as single sensor measurements of the total magnetic field, electrical resistivity logging with Schlumberger probes, and the approach with geophysical pseudosections and tomography).

Method 8 Intensive fieldwalking survey[14]

Objectives and definition

The objective of the intensive fieldwalking survey is a characterization of the areas of high archaeological potential, and determining the extent, structure, and dating of archaeological remains or sites. This is a non-invasive method for recording archaeological remains. Intensive fieldwalking survey is conducted in an orthogonal grid on fields and other surfaces with a disturbed upper soil layer. In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, primary evaluation and recording of the finds, and a professional report.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education).
- 5 workers.

Selection and capture

In order to determine the content and structure of a site, surveys are conducted in the areas with registered cultural heritage and at potential archaeological sites discovered in earlier extensive fieldwalking surveys. Intensive fieldwalking survey is suitable for areas with a disturbed upper soil layer (fields). The surveyed area is fully covered and sampled and the method is complementary to Method 9. The method can be used in most landscapes, except on thick natural and anthropogenic deposits (for example, archaeological layers can be buried under geological deposits of pebbles and clay, or under modern man-made deposits). The method includes a total collection on the surface of the collection unit. Capture density is standardized for the entire territory of Slovenia.

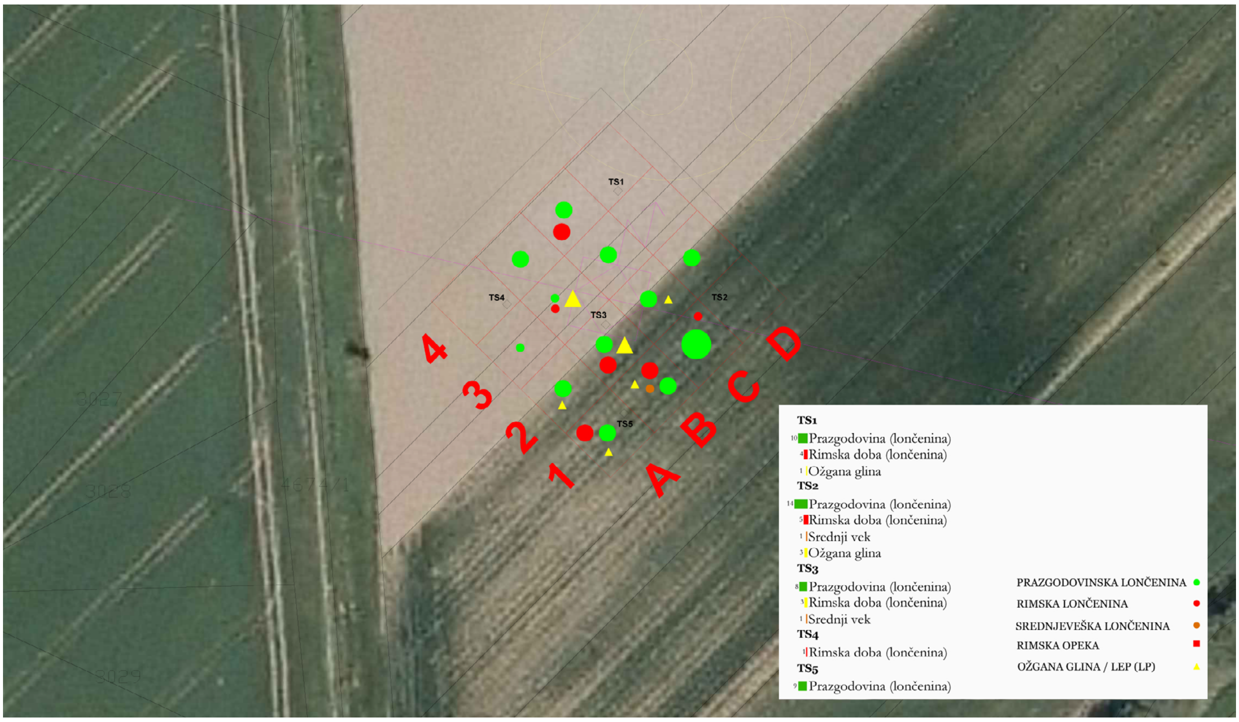

Figure 8 *Map with the results of an intensive fieldwalking survey (archive IPCHS, CPA).*

14 Intensive archaeological fieldwalking survey (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

Method 9 Intensive manuel test pit survey[15]

Objectives and definition

The objective of the intensive shovel test pit survey is a characterization of areas of high archaeological potential, and the determination of the extent, structure, and dating of archaeological remains or sites. It is a low-invasive method of recording archaeological remains. Intensive manuel test pit survey is conducted in grasslands, forests, and other surfaces covered with vegetation. The method is conducted through systematic sampling by digging manuel test pits on an orthogonal grid. The locations of collecting units and test holes are recorded. In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, primary evaluation and recording of the finds, and a professional report.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education).
- 5 workers.

Selection and capture

In order to determine the content and structure of a site, surveys are conducted in the areas with registered cultural heritage and at potential archaeological sites discovered in earlier extensive fieldwalking surveys. Intensive shovel test pit (STP) survey is suitable for grasslands, forests, and other surfaces covered with vegetation. The surveyed area is fully covered and sampled and the method is complementary to Method 8. The method can be used in most landscapes, unless there is no soil at all (Karst Plateau) or in the rare cases where the ground was rapidly buried under thick natural and anthropogenic deposits (e.g. landslides, modern man-made deposits). The method is conducted by digging manuel test pits. Capture density is standardized for the entire territory of Slovenia.

Figure 9 *Extensive fieldwalking survey in progress(archive ZVKDS, CPA).*

15 Intensive archaeological shovel test pit survey (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

Method 11a Borehole drilling – extensive[16]

Objectives and definition

The objective of borehole drilling survey is to assess the archaeological potential, to identify buried ground surfaces and potential archaeological remains in the areas with thick alluvial or anthropogenic deposits and in urban areas. The method allows a precise and correct determination of the thickness of cultural layers and the extent of the area of high archaeological potential. This is a low-invasive method. In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. The survey is conducted by drilling boreholes up to 20 cm in diameter. The precise locations of boreholes are recorded. The survey includes flotation of those borehole contents that are interpreted as layers of anthropogenic origin, while samples for flotation (minimum 10%) are taken from the rest of the borehole contents. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, a primary evaluation and recording of the finds, and a professional report.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education).
- 5 workers.

Selection and capture

The method is suitable for urbanized areas, for non-urbanized areas with thick layers of alluvial and colluvial deposits, for areas where several thick anthropogenic layers are expected, etc. It is used where other extensive sampling methods fail to provide an assessment of the archaeological potential. Capture density is standardized for the entire territory of Slovenia.

Figure 10 *Borehole sampling (archive IPCH, CPA).*

16 Borehole sampling (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

Method 11b Borehole drilling – intensive[17]

Objectives and definition

The objective of intensive borehole drilling survey is to assess the extent and structure, and particularly the stratification in areas of high archaeological potential and in known archaeological sites; especially in the areas with thick alluvial or anthropogenic deposits, in sites with thick stratification, and in urban areas. The method allows a precise and correct determination of the thickness of cultural layers, the determination of the extent of the site, and the selection of the method for further archaeological investigations (in terms of rescue excavations). It thus represents a rationalization of rescue excavations and allows the acquisition of improved data to determine further measures for archaeological heritage protection. This is a low-invasive method. In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. The survey is conducted by drilling boreholes up to 20 cm in diameter. The precise locations of boreholes are recorded. The survey includes flotation of those borehole contents that are interpreted as layers of anthropogenic origin, while samples for flotation (minimum 10%) are taken from the rest of the borehole contents. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, a primary evaluation and recording of the finds, and a professional report.

Capture density is standardized for the entire territory of Slovenia.

Figure 11 *Borehole sampels (archive IPCH, CPA).*

17 Borehole sampling (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

The team:
- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education).
- 5 workers.

Selection and capture

The method should be chosen in areas with registered cultural heritage, in urbanized areas, in non-urbanized areas with thick layers of alluvial and colluvial deposits, in areas where several thick anthropogenic layers are expected, etc. It is used where other intensive sampling methods fail to provide a precise and correct determination of the thickness of cultural layers and the extent of the site. Capture density is standardized for the entire territory of Slovenia.

Method 11c Test pitting by hand [18]

Objectives and definition

The objective of manuel test pitting is to assess the extent, content, structure, and particularly stratification in areas of high archaeological potential and in known archaeological sites. This is an invasive method, conducted by digging test pits with the dimensions of 1 x 1 x 1 m. Sampling by test pits is systematic, in grids or transects. The precise locations of test pits are recorded. The method allows a precise and correct determination of the thickness of cultural layers, the selection of the method for further archaeological investigations (in terms of rescue excavations). It thus represents a rationalization of open area excavations and allows the acquisition of improved data to determine further measures for archaeological heritage protection.

In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, a primary evaluation and recording of the finds, and a professional report.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education).
- 5 workers.

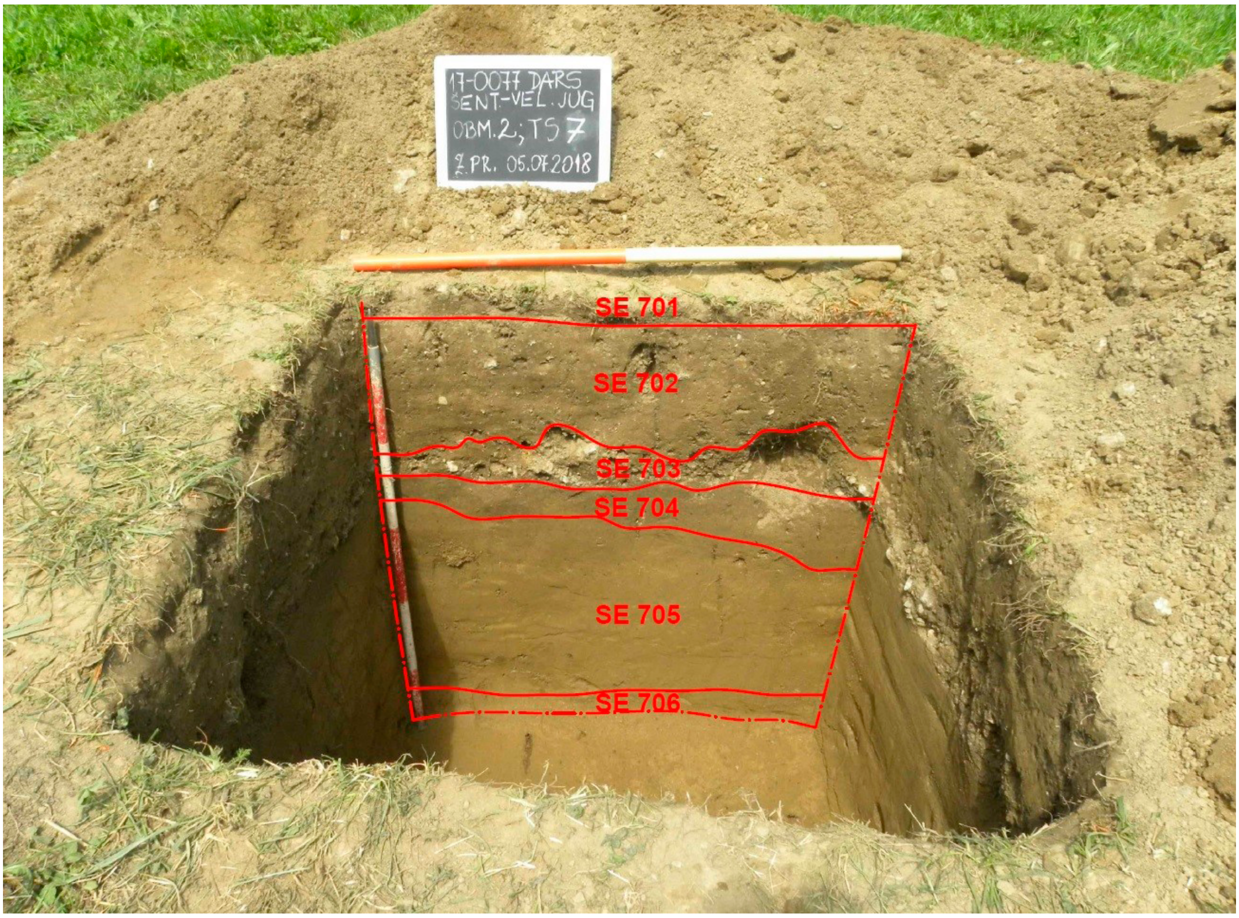

Figure 12 *Intepreted test pit section (archive IPCHS, CPA).*

18 Archaeological test excavations (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

Selection and capture

The method of test pitting by hand is suitable for the verification of stratigraphic situations inside protected archaeological sites or inside newly discovered potential archaeological sites. The objective of manuel test pitting is to determine precisely the content and composition of an archaeological site, to assess its extent, to establish the potential damage level, to confirm the presence of archaeological structures and remains, and to determine the nature and depth of stratigraphy. Capture density is standardized for the entire territory of Slovenia.

Method 12 Machine excavation of test trenches and archaeological documenting with continuous presence of the archaeological team, and archaeological documenting of profiles[19]

Objectives and definition

Machine excavation of test trenches and archaeological recording with the continuous presence of archaeological team, and archaeological recording of sections.

The objective of the survey in the form of archaeological recording of machine excavated trenches is to assess the extent, content, structure, and above all the stratification of areas inside registered archaeological sites and inside newly discovered potential archaeological sites in areas of low archaeological potential. This is an invasive method. The number and size of machine excavated trenches are adapted to the spatial intervention. The precise locations of test trenches are recorded. The method allows a precise and correct determination of the thickness of cultural layers, the selection of the method for further archaeological fieldwork (in terms of open area excavations). It thus represents a rationalization of rescue excavations and allows the acquisition of improved data to determine further measures for archaeological heritage protection.

In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, a primary evaluation and recording of the finds, and a professional report.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education).
- 5 workers.

Figure 13 *Machine excavation of test trenches (archive IPCH, CPA).*

19 Archaeological test excavations (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

Selection and capture

The method of machine excavated test trenches is suitable for the verification of stratigraphic situations inside protected archaeological sites or inside new ly discovered potential archaeological sites in areas of low archaeological potential, and also in the areas where several thick alluvial or colluvial deposits or thick anthropogenic layers are expected. The method is suitable for dolines. Sampling density, i.e. the number and size of machine excavated trenches, is adapted to the spatial intervention. Capture density is standardized for the entire territory of Slovenia.

Method 13 Geophysical surveys – intensive[20]

Objectives and definition

The objective of geophysical surveys is the characterization of areas of high archaeological potential and the determination of the extent and structure of archaeological remains or sites, by identifying geophysical anomalies that can be interpreted as archaeological features.

Geophysical surveys are very non-invasive, allowing the detection of remains (anomalies) by measuring certain physical properties of the subsurface record, with no physical intrusion into the subsurface layers.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education.
- 1 worker.

Selection and capture

The method is suitable for the verification of the stratigraphic situation inside registered archaeological sites. The choice of geophysical surveys and the selection of a method (or better, a combination of methods) are influenced by several related factors: area size, area limitations (electrical power lines, utility networks, geology), the expected 'type' of the archaeological site/record (the content and composition of the site, the depth of the remains, post-depositional processes), and other factors. Geophysical surveys encompass the area that is as large as possible within the circumstances. Geophysical methods depend on the natural conditions of the area (the geophysical properties of the subsurface record), and hence the principle is that since they are complementary to one another, the best results can be expected when using a combination of different methods. Natural conditions also demand a certain degree of flexibility when it comes to choosing the method. The selection of a method (electrical resistance method, magnetic method, ground penetrating radar, etc.) depends strongly on the environment where the survey takes place, whether this is the geophysical properties of the subsurface record (pedological, geological, anthropogenic factors) or simply the fact that, if research is conducted in urban environment with buildings and castles, or close to the utilities infrastructure (electrical power lines etc.), some methods are unsuitable. It is also possible to use some of the new methods that are not among the above-mentioned most common ones (e.g. the otherwise very established method of measuring magnetic susceptibility, and the very-low-frequency EM method, which measures conductivity and magnetic susceptibility) or the methods that are only emerging (seismic method, self-potential method, thermal method, electrostatic method, electromagnetic and magnetic-tellurium methods of very low frequencies, as well as single sensor measurements of the total magnetic field, electrical resistivity logging with Schlumberger probes, and the approach with geophysical pseudosections and tomography). Geophysical methods depend on the natural conditions of the area (the geophysical properties of the subsurface record), and hence the principle is that since they are complementary to one another, the best results can be expected when using a combination of different methods. Natural conditions also demand a certain degree of flexibility when it comes to choosing the method. The selection of a method (electrical resistance method, magnetic method, ground penetrating radar, etc.) depends strongly on the environment where the survey takes place. The conditions of urban environment (density of buildings, vicinity of infrastructure lines) should also be taken into account, since it can influence the results of a survey. Further, it should be possible to use some new methods that are not among the above-mentioned most common ones (e.g. the otherwise very established method of measuring magnetic susceptibili-

20 Geophysical surveys (Act on Archaeological Research, Official Gazette of the Republic of Slovenia, No. 3/2013).

ty, and the very-low-frequency EM method, which measures conductivity and magnetic susceptibility), or the methods that are only emerging (seismic method, self-potential method, thermal method, electrostatic method, electromagnetic and magnetic-tellurium methods of very low frequencies, as well as single sensor measurements of the total magnetic field, electrical resistivity logging with Schlumberger probes, and the approach with geophysical pseudo-sections and tomography).

Measurements are usually taken in a regular grid of quadrants with a specified distance between transects and measurement points. Capture density in geophysical surveys depends on the technical properties of the selected instrument (i.e. the method) and on the objective of the survey. Capture density is standardized for the entire territory of Slovenia.

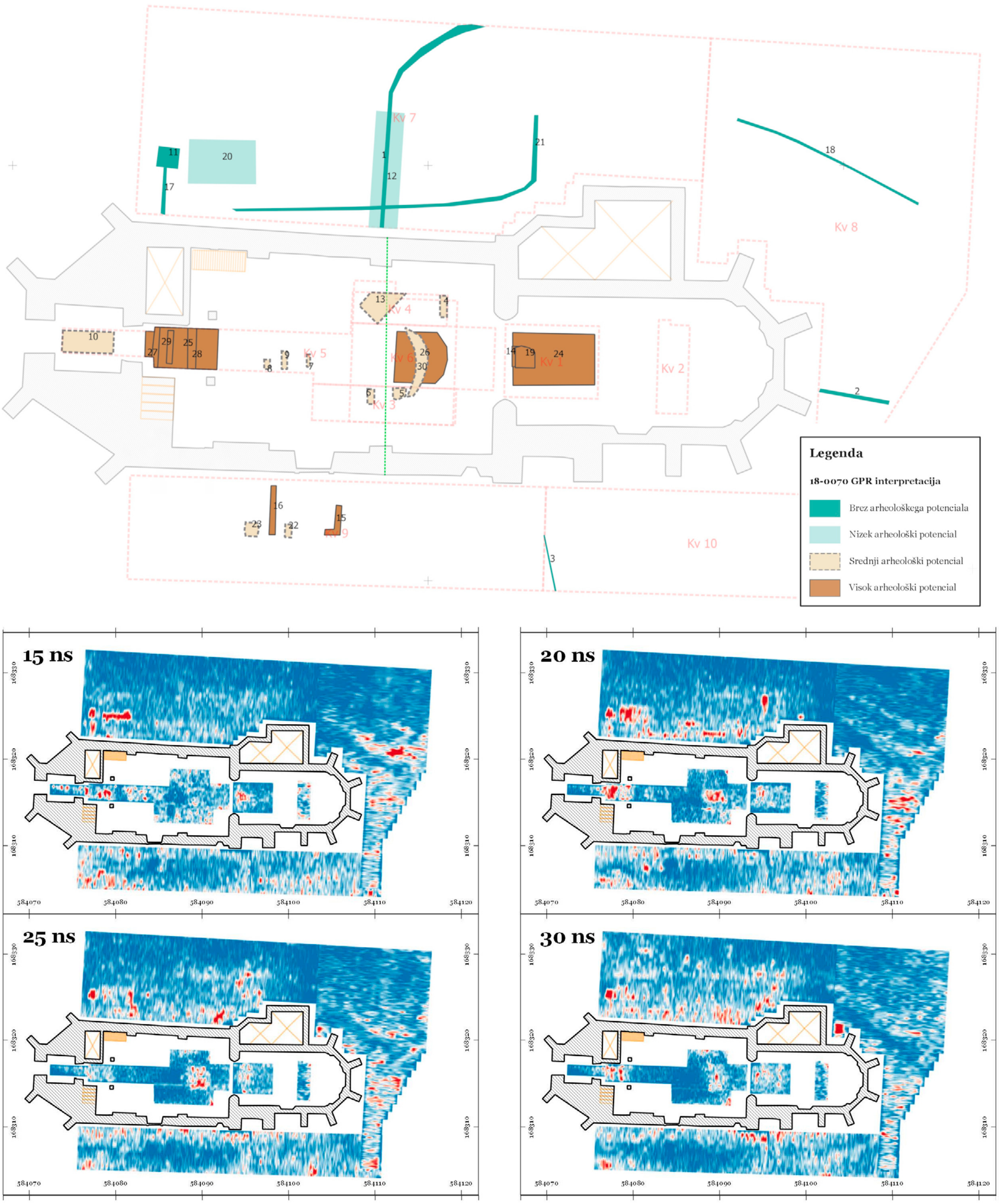

Figure 14 *Geophyisical survey, results of GPR survey (archive IPCH, CPA).*

Method 14 Archaeological excavation

Objectives and definition

Archaeological excavation is an invasive research method, the goal of which is a systematic discovery, documentation, and study of a stratified archaeological record, and the collection, documentation and study of all archaeological finds and other relevant direct and indirect traces of past human activities in the selected area. Archaeological excavations are conducted manually and stratigraphically. Only the upper arable layer of the soil can be removed by a machine (the same goes for the layers of modern debris, deposits, colluvial and alluvial deposits, etc) if the area has undergone the analysis with the methods of preliminary surveys, determining the content and composition of the site, which enables a clear identification of the stratigraphy.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology (in accordance with the *Act*).
- Deputy principal investigator: archaeologist – BA or MA in archaeology (in accordance with the *Act*).
- Team members: 4 assistants or documentalist technicians (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree, conservator technician documentalist – equiv. of upper secondary education).
- 6 workers.

The team consists of 1 archaeologist, 4 technicians, 6 workers. One team excavates in one sector, which is determined by the volume of the excavation, the available time, and financial resources.

Selection and capture

Archaeological excavation is used as a research method when archaeological sites are endangered, in accordance with the strategies for their protection. The method is used when archaeological sites are directly endangered; i.e. when expert services have studied all optimization possibilities and new technical solutions for the planned special intervention, but the preservation of the archaeological site (or a part of it) within landscape is still not ensured. Archaeological excavations can also be conducted within the framework of archaeological research projects.

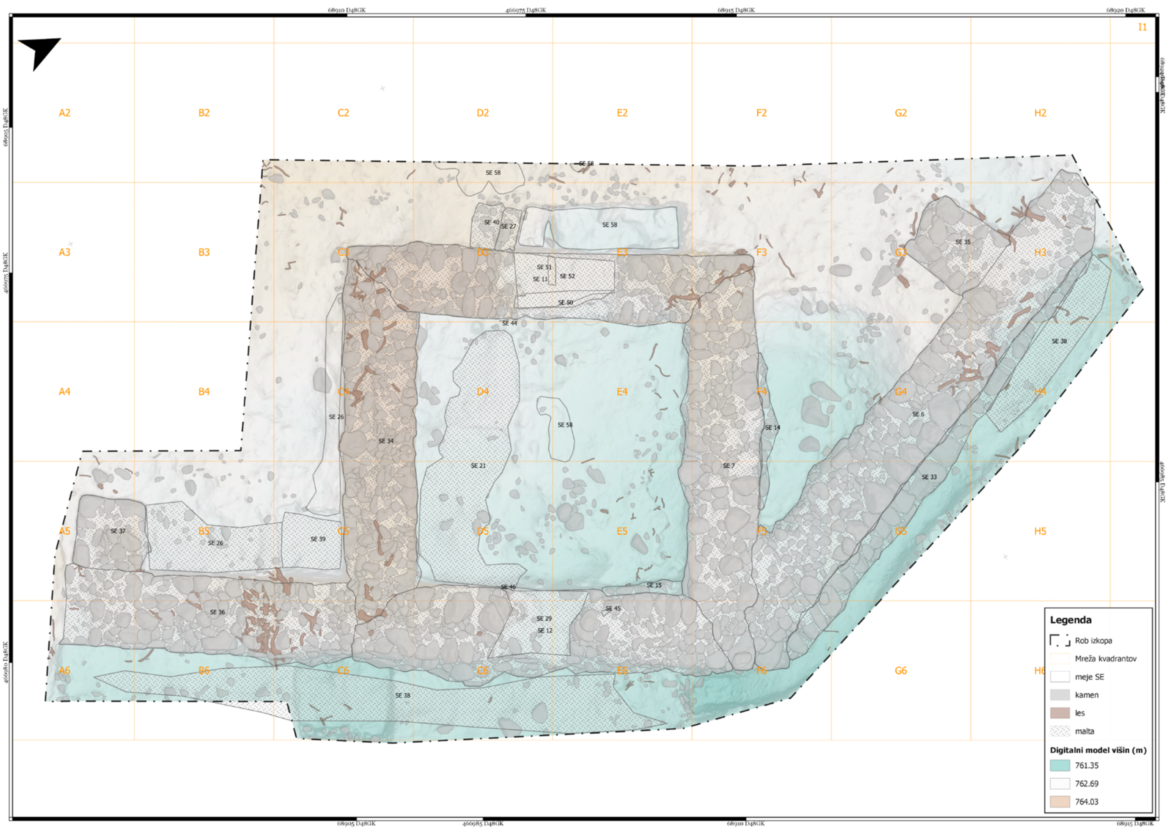

Figure 15 *Cumulative plan of excavations (archive IPCHS, CPA).*

Method 15 Other investigations

15.1 Inspection of standing structures and archaeological building analysis

Archaeological inspection of standing structures and building analysis are non-invasive procedures for the identification of archaeological contents of buildings. Archaeological inspection of standing structures documents the presence, form, structure, dimensions, and preservation of buildings and their constituent parts. Building analysis complements the inspection. The objective of building analysis is documenting the standing stratigraphy and determining the order of construction and renovation of the building, its elements, construction processes, and changes in the building. Building analysis is a low-invasive method; it might include cleaning surfaces and taking samples. It should, however, never intervene with the substance of the building and the stratigraphic record. Inspection of standing structures and archaeological building analysis follow a thorough historical analysis of the building.

The recording of building elements, finds, samples, and interventions follows the same procedures as the recording of archaeological excavations.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education.
- 1–3 workers.

15.2 Documenting destruction

Documenting of destruction is an invasive archaeological procedure with the objective of recording the state of archaeological remains or the stratigraphic record after suffering destruction or damage caused in an unprofessional, unsupervised manner. The very act of destruction or damage (together with the circumstances and subjects of the destruction or damage) should be documented, as well as the consequences on archaeological features. Documenting the act of destruction and the state of archaeological features after the destruction follows the same procedures as the recording of archaeological excavations.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education.
- 1–3 workers.

15.3 Archaeological watching brief documenting and investigations during construction

An archaeological watching brief during construction is an invasive method of removing buildings or parts thereof and monitoring other intrusions into the ground or into the existing structures during development works. An archaeological watching brief during construction includes the identification and documentation of archaeologically relevant phenomena during and after such interventions. An archaeological watching brief An archaeological watching brief during construction follow the same procedures as the recording of archaeological excavations. They record the removal of archaeological features, finds, the distribution of individual building elements.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology.
- Team members: assistant or documentalist technician (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree / conservator technician documentalist – equiv. to upper secondary education.
- 1–3 workers.

4 Minimum Standards Of Underwater Research

A generalized statement would be that underwater archaeology deals with the archaeological sites that are submerged under water. There is a wide range of sites, which can be found in very different environments: on open-sea bottom, in coastal and tidal zones, in rivers and lakes with their shores, in ponds, in artificial reservoirs and navigation channels, in submerged caves, in man-made tunnels and wells. Working conditions such as depth, visibility, currents, traffic, pollution, etc. vary considerably among them. As with all archaeological investigations and in line with international guidelines, the strategy of underwater research as a general rule leans towards the acquisition of the largest possible amount of information about the site while causing the least possible damage. It essentially depends on the available time, the amount of funding, and the availability of equipment. The discipline nevertheless has its minimum standards, which should not be forgotten or omitted in any investigation.

The information about the sites endangered by certain processes and activities are gathered in various ways in a sequence from historical analysis, analysis of data acquired by remote sensing methods, extensive and intensive field walking surveys, analysis of the results of geophysical surveys, manuel test trenches and only at the end of the chain, if spatial intervention is unavoidable, there is archaeological excavation. Integral to all of these procedures is careful recording, which documents the state in the field during the intervention. The result of each procedure (or several procedures) is a field record, a work journal, an ordered collection of (potential) finds, as well as a report on the work performed and the results obtained.

When the remains that have already been registered are exposed to dangers such as gradual erosion, biological degradation and/or corrosion, there is the possibility of a cyclical monitoring of such sites, which includes documenting the potential damage and any newly exposed elements.

4.1. Preliminary underwater investigations

Method 10a Extensive underwater survey

Objectives and definition

The objective of an extensive underwater 'swim-over' survey is the assessment of archaeological potential in an underwater environment. The survey is conducted in a previously unexplored area, outside protected archaeological sites, with the objective of acquiring basic data on the distribution of archaeological finds in an underwater environment. The method results in identifying areas with a high archaeological potential. This is a non-invasive method. It includes a total collection of archaeological finds on underwater surfaces or under light sediments which can be removed by hand. The collection is performed in transects within a collection unit.

In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, a primary evaluation and documentation of the finds, and a professional report.

The team:
- Principal investigators: archaeologist – BA or MA in archaeology with the appropriate diving qualifications (minimum CMAS 3* or a comparable level of qualification).
- Team members: 2 technicians (archaeologist with the 1st cycle Bologna programme degree and the appropriate diving qualifications).
- 2 workers with the appropriate diving qualifications diving supervisor with appropriate diving qualifications.

Selection and capture

Extensive underwater surveys are conducted in previously unexplored underwater environments, outside protected archaeological sites.

This is a non-invasive method of recording archaeological remains on the surface or in the sediment. In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. Capture density is standardized for the entire territory of Slovenia.

Figure 16 *Underwater survey (archive IPCH, CPA).*

Method 10b Intensive underwater survey

Objectives and definition

The objective of the intensive underwater survey is to characterize the areas of high archaeological potential, and to determine the extent, structure, and dating of archaeological remains or sites. This is a non-invasive method for recording archaeological remains. The intensive underwater survey includes a total collection of archaeological finds on underwater surfaces or under light sediments which can be removed by hand. In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in the landscape and the development of cultural landscape. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, a primary evaluation and record of the finds, concluding with a professional report.

The team:

- Principal investigators: archaeologist – BA or MA in archaeology with the appropriate diving qualifications (minimum CMAS 3* or a comparable level of qualification).
- Team members: 2 technicians (archaeologists with the 1st cycle Bologna programme degree and the appropriate diving qualifications).
- 2 workers with the appropriate diving qualifications diving supervisor with appropriate diving qualifications.

Selection and capture

In order to determine the content and structure of a site, surveys are conducted in the areas with registered cultural heritage and at potential archaeological sites discovered in earlier extensive fieldwalking surveys. Capture density is standardized for the entire territory of Slovenia.

Figure 17 *Intensive underwater survey in progress (archive IPCHS, CPA).*

Method 10c Underwater test pits

Objectives and definition

The objective of underwater manuel test pitting is to assess the extent, content, structure, and particularly stratification in areas of high archaeological potential and in known archaeological sites. The method of test pitting by hand is suitable for the verification of stratigraphic situations inside protected archaeological sites or inside newly discovered potential archaeological sites in underwater environments. The objective of manuel test pitting is to determine precisely the content and composition of an archaeological site, to assess its extent, to establish the potential damage level, to confirm the presence of archaeological structures and remains, and to determine the nature and depth of stratigraphy. This is an invasive method. An inherent part of the survey is the creation of an archive, which includes the processing and analysis of the material, a primary evaluation and documentation of the finds, and a professional report. Capture density is standardized for the entire territory of Slovenia.

The team:

- Principal investigators: archaeologist – BA or MA in archaeology with the appropriate diving qualifications (minimum CMAS 3* or a comparable level of qualification).
- Team members: 2 technicians (archaeologists with the 1st cycle Bologna programme degree and the appropriate diving qualifications).
- 2 workers with the appropriate diving qualifications diving supervisor with appropriate diving qualifications.

Selection and capture

The method allows a precise and correct determination of the thickness of anthropogenic layers, the selection of the method for further archaeological investigations (in terms of rescue excavations). It thus represents a rationalization of rescue excavations and allows the acquisition of improved data to determine further measures for archaeological heritage protection. In addition to archaeological remains, the survey also records other indicators significant for the understanding of anthropogenic influences in landscape.

4.2. Underwater archaeological excavation

Objectives and definition

Archaeological excavation is an invasive research method, the goal of which is a systematic discovery, documentation, and study of a stratified archaeological record, and the collection, documentation and study of all archaeological finds and other relevant direct and indirect traces of past human activities in the selected area. Underwater archaeological excavations are conducted manually and stratigraphically.

The team:

- Principal investigator: archaeologist – BA or MA in archaeology (in accordance with the *Act*) with the appropriate diving qualifications (minimum CMAS 3* or a comparable level of qualification).
- Deputy principal investigator: archaeologist – BA or MA in archaeology (in accordance with the *Act*) with the appropriate diving qualifications (minimum CMAS 3* or a comparable level of qualification).
- Team members: 4 assistants or documentalist technicians (e.g. assistant conservator – archaeologist with the 1st cycle Bologna programme degree, conservator technician documentalist – equiv. of upper secondary education) with the appropriate diving qualifications.
- 6 workers with the appropriate diving qualifications diving supervisor with appropriate diving qualifications.

Selection and capture

Archaeological excavation is used as a research method when archaeological sites are endangered, in accordance with the strategies for their protection and in the context of archaeological research projects. The method is used when archaeological sites are directly endangered; i.e. when expert services have studied all optimization possibilities and new technical solutions for the planned special intervention, but the preservation of the archaeological site (or a part of it) within landscape is still not ensured.

5 Minimum Standards Of Post-Field Processing Of Data And Material

Archaeological investigation archive

This chapter presents the minimum standards of processing the acquired data, as well as handling and storing the finds from all phases of research.

5.1. Processing captured data

Objectives and definition

The objective of data processing is the presentation of field investigation results based on the analysis and processing of field documentation. Fieldwork documentation includes, in addition to written and digital field records, all other kinds of record made during the investigation. These include written documents (e.g. forms, lists, field journal, construction journal), drawings, slides, photos (conventional, negatives, contact copies), reports and publications of the research, and digital documents (e.g. databases, photos, videos, photo sketches, 3D models, digitised documents).

During the processing of the captured data it should be ensured that the primary data is kept in unchanged original form and content, separately from the data that was interpreted and changed during the processing.

All digital data requires a systematic and consistent approach to the organisation and terminology used in labelling/identifying the contents and files, since this is the only way to achieve that the data can be linked and searched.[21]

Selection and capture

Processing the captured data is a constituent part of any field investigation.

5.2. Primary processing of the finds

Objectives and definition

The objective of primary processing is to determine the extent and composition of the finds, and to assign them a general date them.

Primary processing includes cleaning, drying, primary conservation (protection from decay), evaluation and quantification, and packaging of the finds.

Figure 18 *Post-excavation process of finds (archive IPCH, CPA).*

21 The databases of individual investigations are currently using the MS Access software. The data can be viewed either as Access charts or with a computer module for processing and viewing data.

Selection and capture

While all the finds are subjected to it, the procedure is specific, depending on the type of material (composition) and the state of preservation of the finds.

5.3. Secondary processing of the finds

Objectives and definition

The objective of secondary processing is a thorough processing of characteristic finds. Secondary processing includes drawing, photographing, and formal, typological, and technological processing. Secondary processing results in a systematic collection of finds, aligned with the documentation on finds collections.

Figure 19 *Photo and drawing of a Roman scale armour (archive IPCH, CPA).*

Selection and capture

The procedure follows the primary processing of the finds. A thorough processing of the material is performed on a selection of characteristic finds. The specific processing procedure depends on the material (composition) and the state of preservation of the finds.

5.4. Specialist analyses

Objectives and definition

The objective is to answer specific questions about the origin, composition, dating, and function of finds and structures, as well as questions related to past environmental conditions, which complement our knowledge about sites and finds.

Selection and capture

The selection of procedures depends on the results of a specific investigation and the material obtained. Excavations are always accompanied by geological surveys. Specific types of finds always demand specific analyses, e.g. physical anthropological analysis, numismatic analysis, epigraphic analysis, etc.

5.5. Storage

Objectives and definition

The objective is to provide temporary storage for the original documentation archive (in unchanged form and content) and the finds, until they are handed over to the relevant museum; and to provide permanent storage of the digital archive of the site.

Selection and capture

Temporary storage of the original documentation and finds until they are handed over to the relevant museum, and permanent storage of the digital archive of the site is an integral part of any investigation. Specific storage procedures depend on the type of the material.

Figure 20 *Temporary storage of finds at ZVKDS, CPA (archive IPCH, CPA).*

5.6. Site publication (first report)

Objectives and definition

The objective of the first publication is to determine the content, function, and chronology of the site, on the basis of typologically and chronologically clearly identifiable finds and contexts.

Selection and capture

The first report is an integral part of any investigation. With most non- or low-invasive surveys, and also with some intensive investigations, the first report is also the final one. The first report includes primary processing of the finds, without specialist analyses.

5.7. Site publication (final report)

Objectives and definition

The objective of the final publication is a comprehensive analysis and interpretation of investigation results, including any specialist analyses.

Selection and capture

As a rule, all excavations and most invasive investigations should result in a final report.

6 Archaeological Fieldwork Archive

Objectives and definition

One or several methods can be used in archaeological fieldwork. Each method used generates documentation on the conduct and the results of the fieldwork. Primary documentation is kept in its unchanged original form and content. Any processing of the material and documentation should ensure traceability and enable the recovery of the original record.

Selection and capture

Each investigation generates work documentation and investigation results. The result of different archaeological fieldwork is the archive of digital and non-digital documentation, finds, and samples.

Figure 21 *Temporary storage of archaeological documentation at ZVKDS, CPA (archive IPCH, CPA).*

7 Databases

7.1. Archaeological research record

Objectives and definition

This is a database of all archaeological fieldwork within the territory of the Republic of Slovenia. It includes systematically collected and organized data (pre-existing and newly acquired) on preventive archaeological fieldwork, science-based investigations, and the development of archaeological methods. This is a centrally managed GIS database on all preliminary archaeological investigations conducted by the CPA and other qualified practitioners, linked with the cultural heritage information system, which is operated by the Ministry of Culture.

Selection and capture

It includes all fieldwork from the territory of the Republic of Slovenia, with data on the fieldwork project (extent, method, results, etc.) and a comprehensive report in digital form.

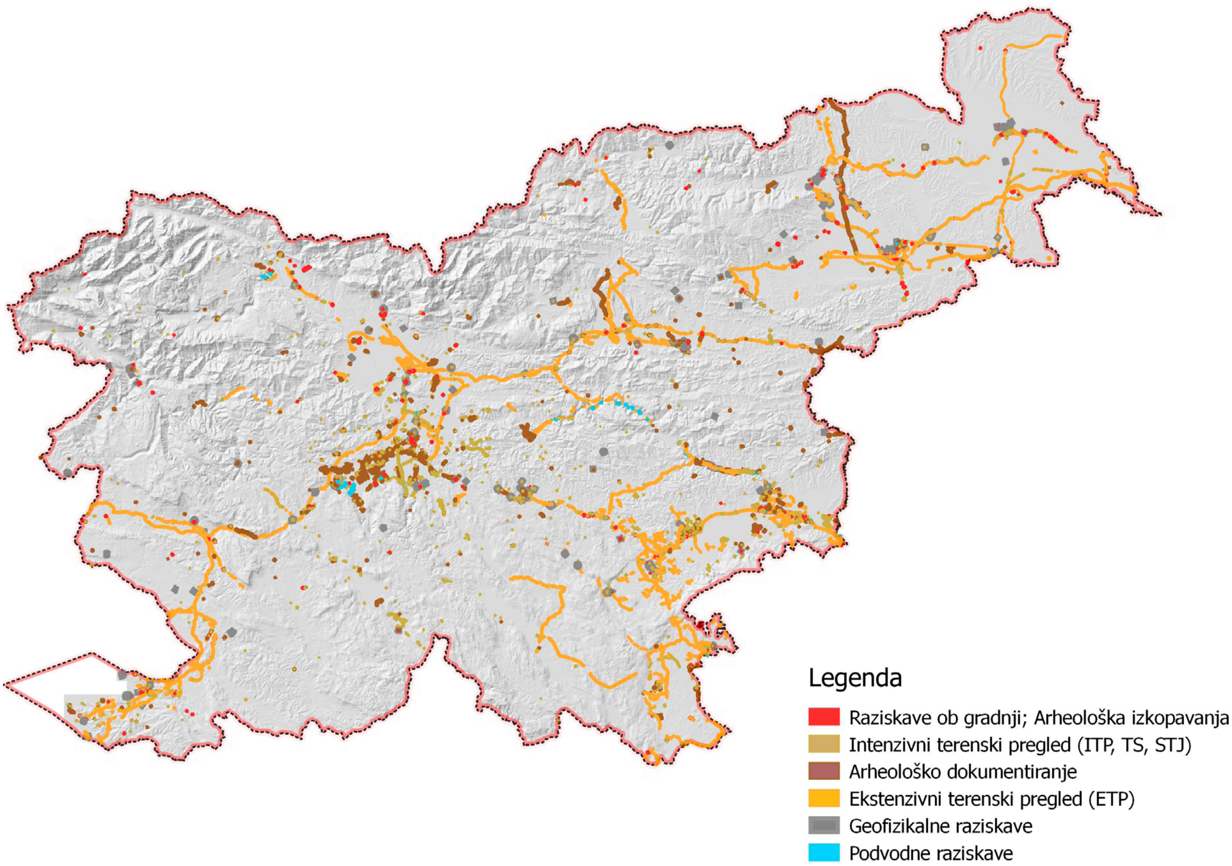

Figure 22 *Map overview of archaeological investigations in the Archaeological research record (archive IPCH, CPA).*

7.2. Basic database of finds

Objectives and definition

Basic Database of Finds is a brief overview of pottery, organized by basic criteria. It is a referential collection of finds, enabling the identification of those finds acquired during the assessment of the archaeological potential that are difficult to identify.

Selection and capture

Basic Database of Finds includes finds that are characteristic in terms of dating, technology, and typology.

- Site: Zgornje Radvanje.
- Year of the research: 2007 in 2008.
- Facility 5, SU 271.
- Phase: 2.
- Form: bowl.
- Fabric: very fine.
- Dating: 4350–4000 BC.

Figure 23 *An example of an entry in the database of the finds (archive IPCH, CPA).*

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